

■ Office of the Inspector General, U.S. EPA

A catalyst for environmental improvement

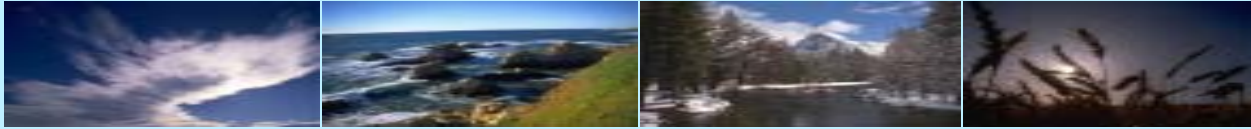


Indicator soup - NAPAP, EMAP, GPRA, and Salt to Taste

What is an indicator and why do we use them?

What are the drivers behind the use of environmental indicators?

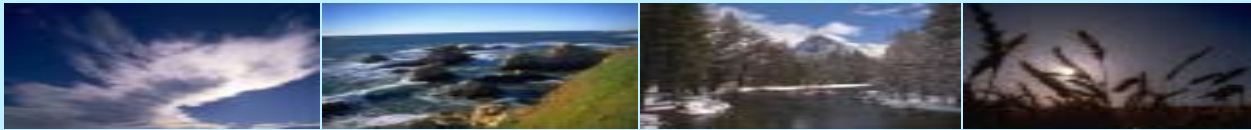
■ **Rick Linthurst**
Science Advisor
18 May 2004



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■ Objectives

- Provide some history to the indicator debate, moving toward indicator as a verb I suspect
- Flash back to what I think, certainly in EPA history, as a near perfect study using indicators
- Encourage you not to allow the debate to stagnate waiting for anything divine to come along, this can be in your hands

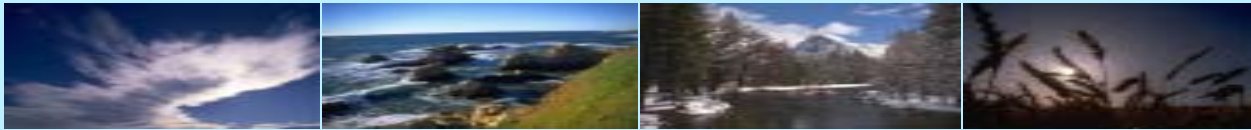


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■ So what is an indicator?



1. One that indicates, of course
2. Any of various statistical values that together provide an indication of the condition or direction of human health or ecosystems..



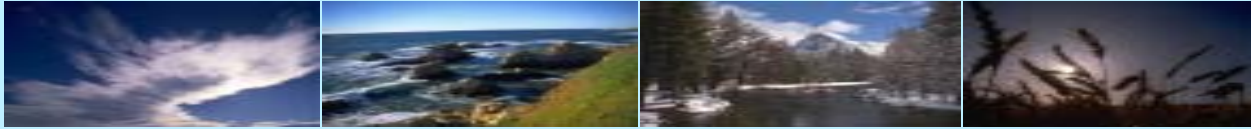
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■ Or maybe.....

A parameter or a value derived from parameters that describe the state of the environment and its impact on human beings, ecosystems and materials, the pressures on the environment, the driving forces and the responses steering that system. An indicator has gone through a selection and/or aggregation process to enable it to steer action. Indicators describe, analyze, and present scientifically based information on environmental conditions and trends, and their significance. Indicators help to elucidate the effects of human activities and natural processes. They can also help to assess future implications of these factors for the integrity of ecosystems and their abilities to support human health and quality of life.

an ecological indicator is “a characteristic of an ecosystem that is related to, or derived from, a measure of biotic or abiotic variable, that can provide quantitative information on ecological structure and function.”

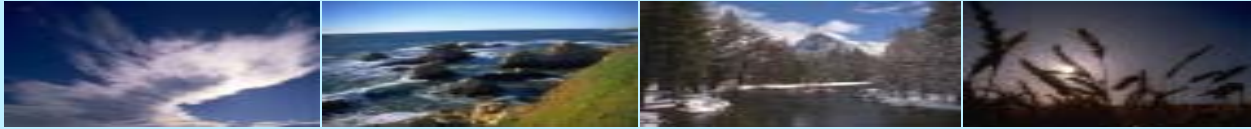
And on, and on and....



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■ **Currently Proposed:** *"Indicator" - For EPA's Report on the Environment,*

an indicator is a numerical value derived from actual measurements of a pressure, state/ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.

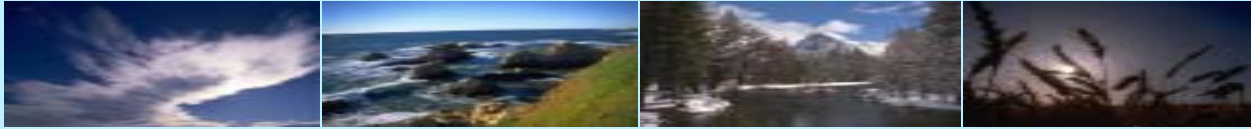


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■ Certainly important but.....why do we use them anyway?

- The key is:
 - Are the things we care about getting better or worse?
 - Are actions having the desired effect?
 - What do we need to measure/monitor to answer those questions in general or specifically?

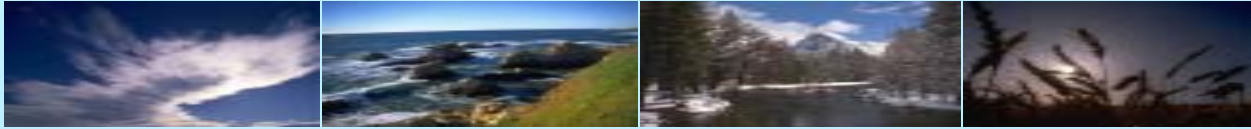




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■ Indicators can be used to:

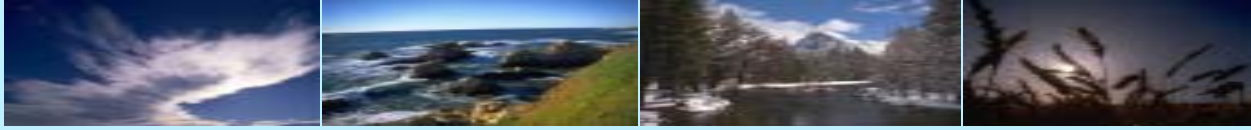
- Provide broad perspective on ecological and environmental issues;
- Encourage a comprehensive look at all environmental factors and associated social and economic issues;
- Track progress of policies as a whole;



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■ Indicators can be used to:

- Highlight remaining problems;
- Help set priorities, particularly for research and monitoring, and among emerging issues needing new or improved policy prescriptions;
- Educate the public, media, and others; and
- Feed into economic and policy analysis (U.S. EPA, 1996).



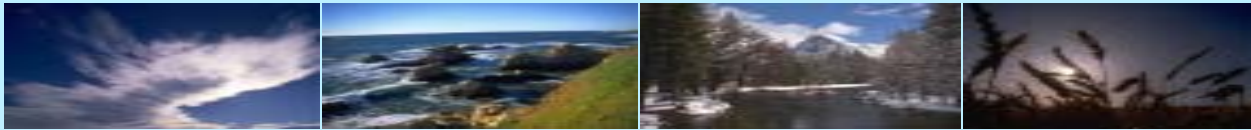
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■ Who are the indicator players?

Scientists are the audience most interested and/or engaged by raw data that can be analyzed statistically.

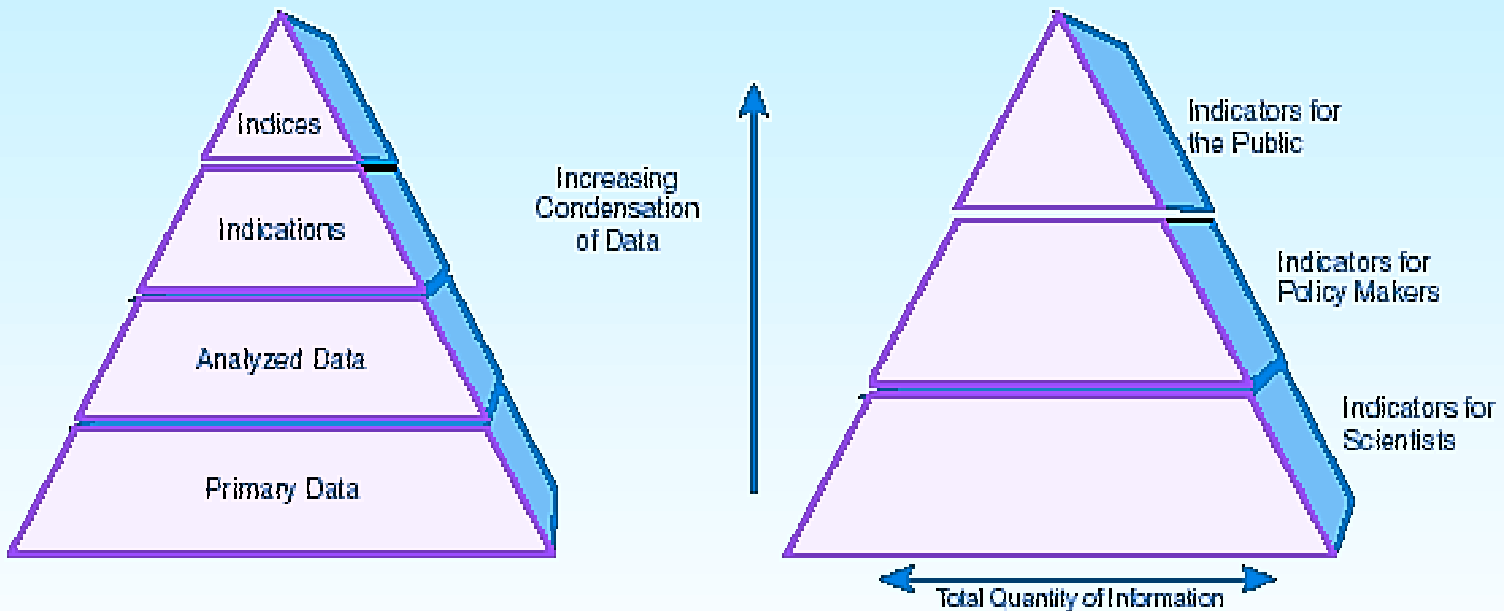
Policy makers have a preference for data related to policy objectives, evaluation criteria, and targets or goals.

The public is assumed to prefer unambiguous messages, free of redundancy, presented as single indicators.



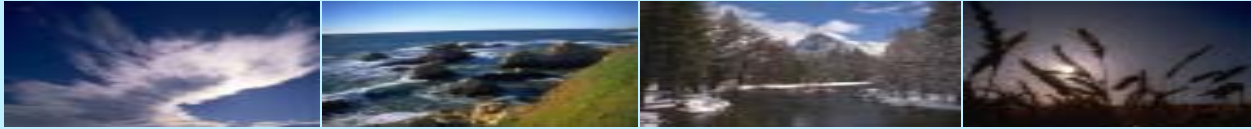
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Exhibit A-1. The Information Pyramid



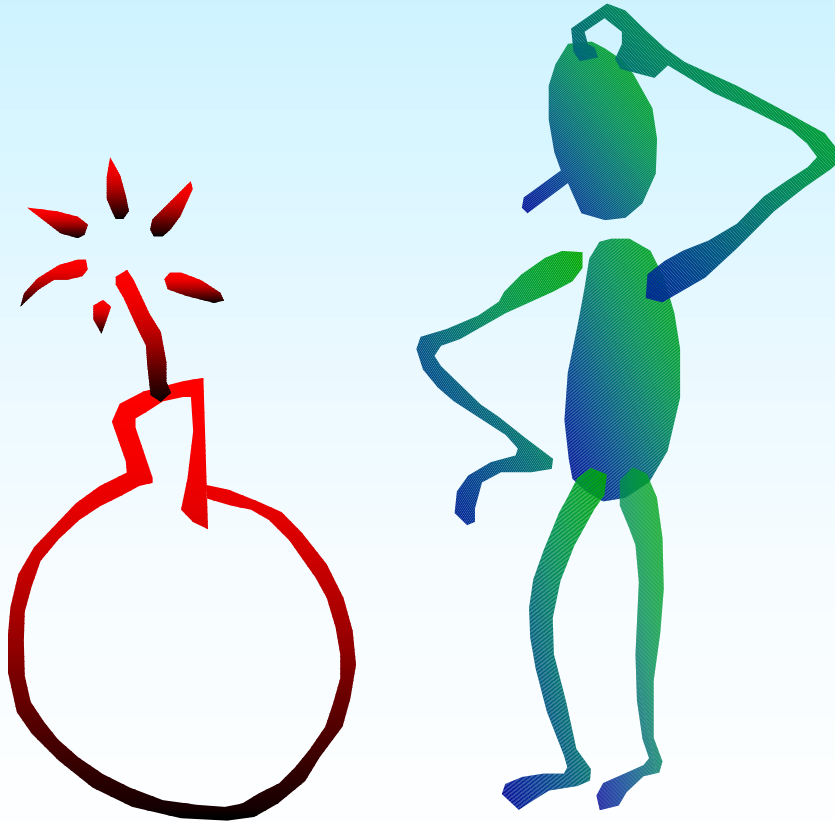
Source: Hammond, et al., 1995 and Braat, 1991 respectively.

Exhibit A-1: The Information Pyramid and the relationships among indicators, data, and information presented in a comparable, contrasted manner. Sources: Hammond, et al., 1995 and Braat, 1991 respectively.

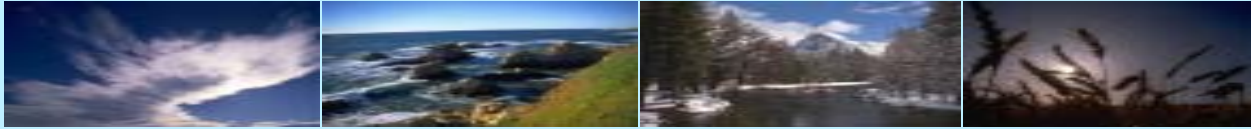


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■ Why Worry?



- Ancient History – the 1990s
 - SAB reports
 - Measuring for Results
- Makes good sense
- Now it's required
- BUT..... as we will see



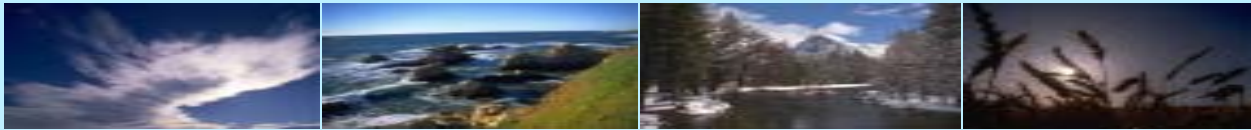
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■ The Results Act



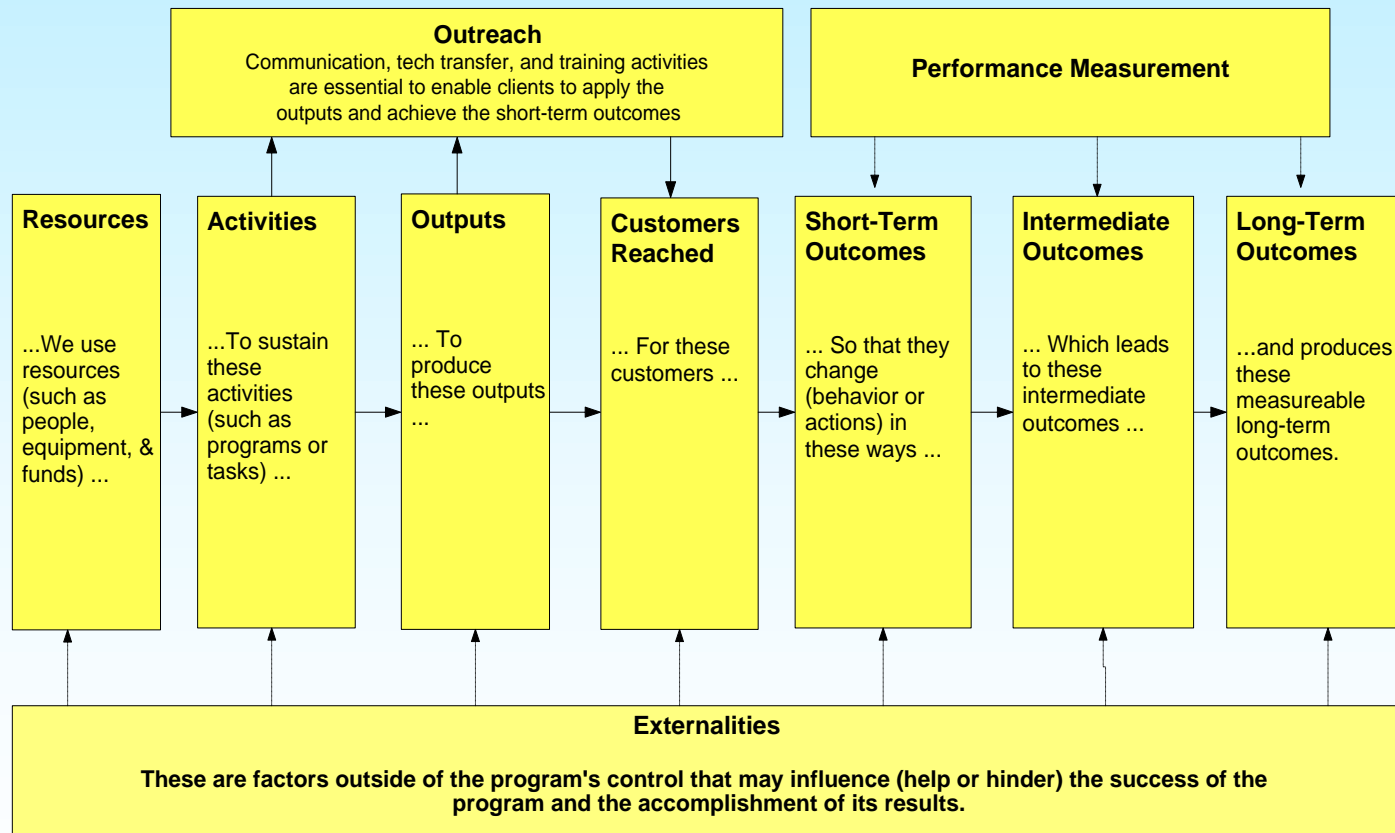
August 3, 1993,
President Clinton signs
the Government
Performance and Results
Act.

“The law simply requires that we chart a course for every endeavor that we take the people’s money for, see how well we are progressing, tell the public how we are doing, stop the things that don’t work, and never stop improving the things that we think are worth investing in.”

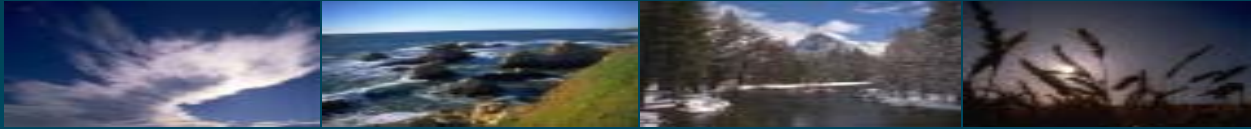


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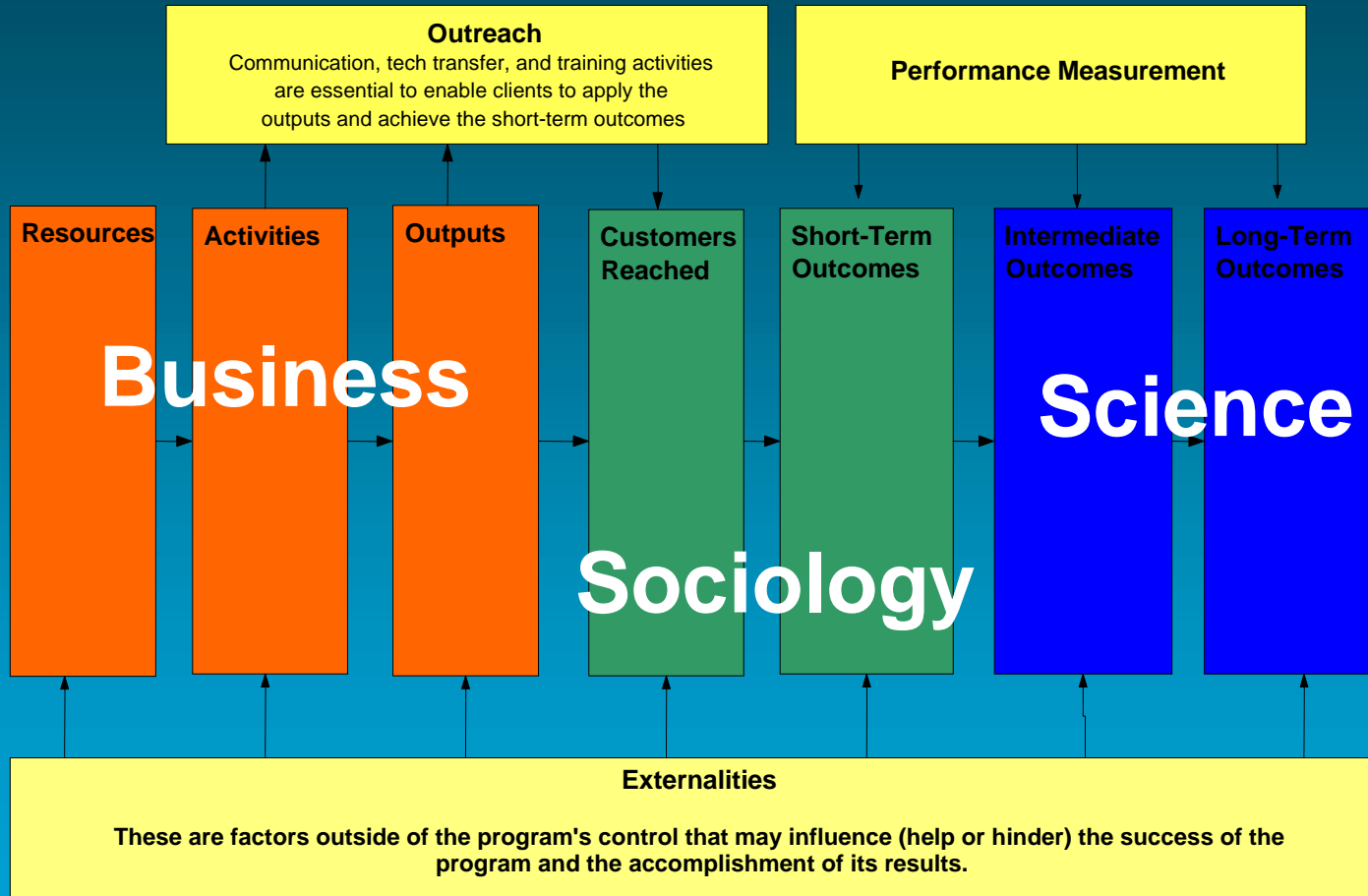
Program Design Proceeds from Right to Left

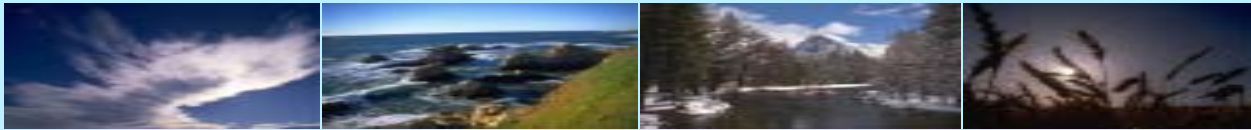


Program Evaluation Proceeds from Left to Right



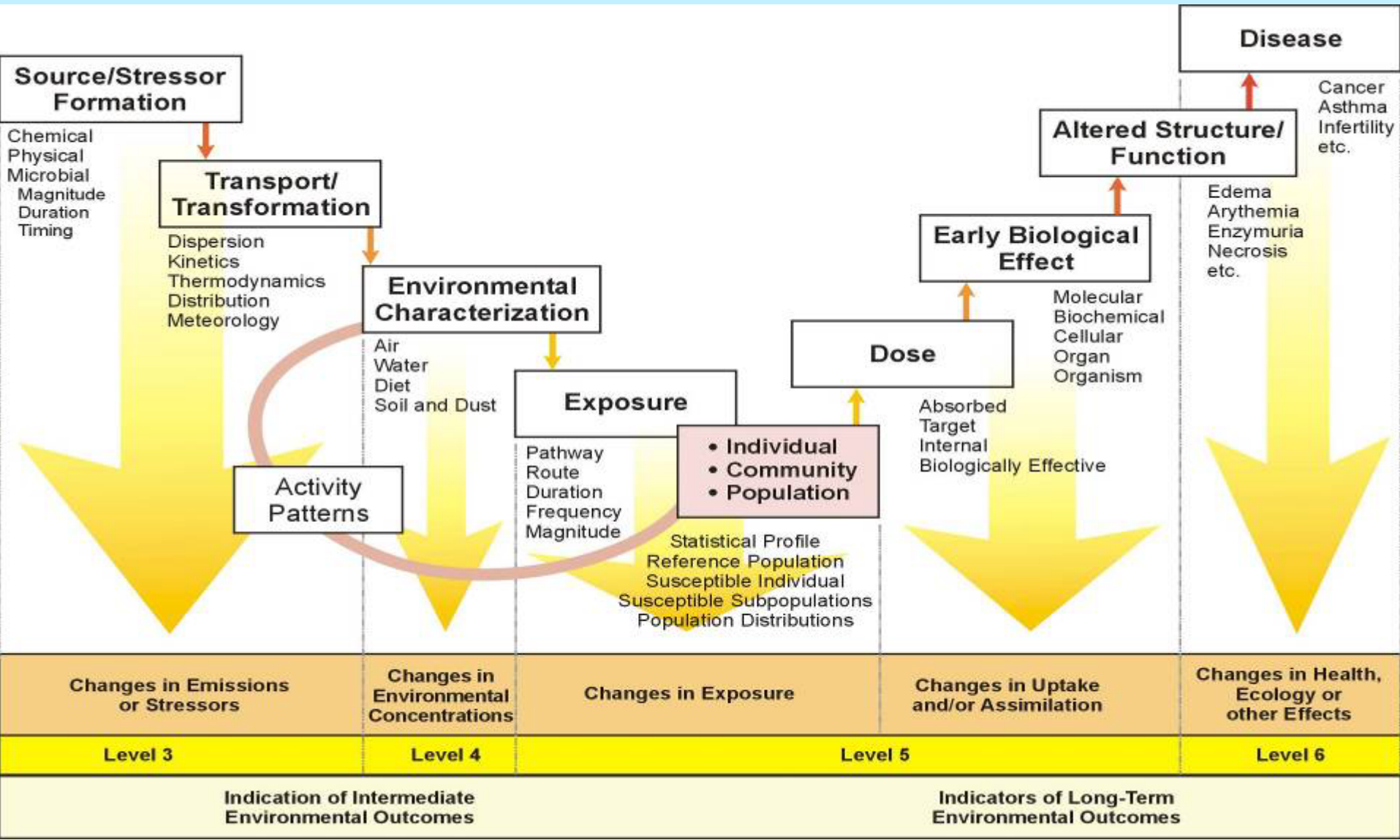
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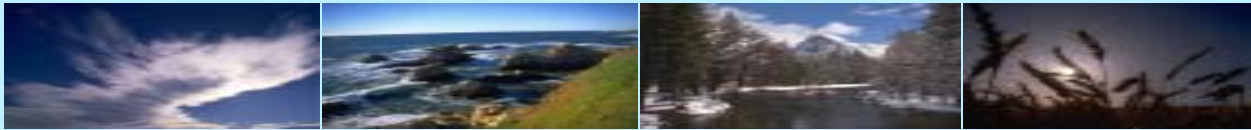




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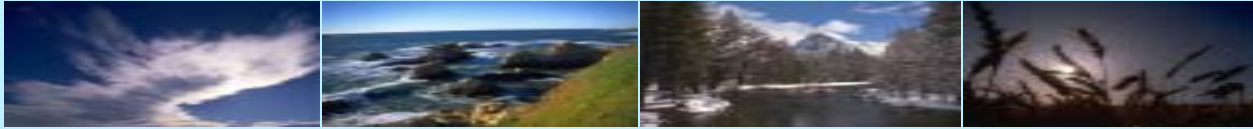
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“What do you mean you don’t know how many acid lakes there are?”

William Ruckelshaus - EPA Administrator - early 1980s

Simple Question Wanting to Know How Big the Problem Was.

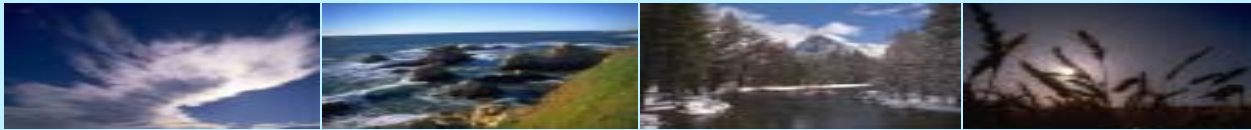
Simple Indicator for Lakes and Stream – Acid Neutralizing Capacity (ANC)



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■ Fade to an earlier time.....



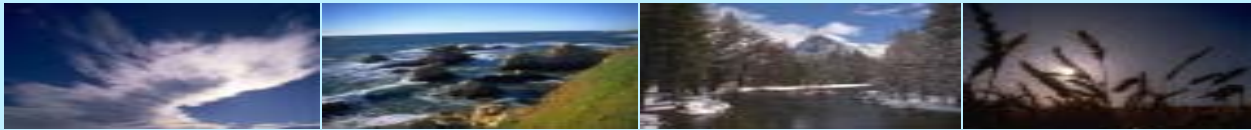


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■ Have Our Policies Made a Difference: Clean Air Act Amendments of 1990?

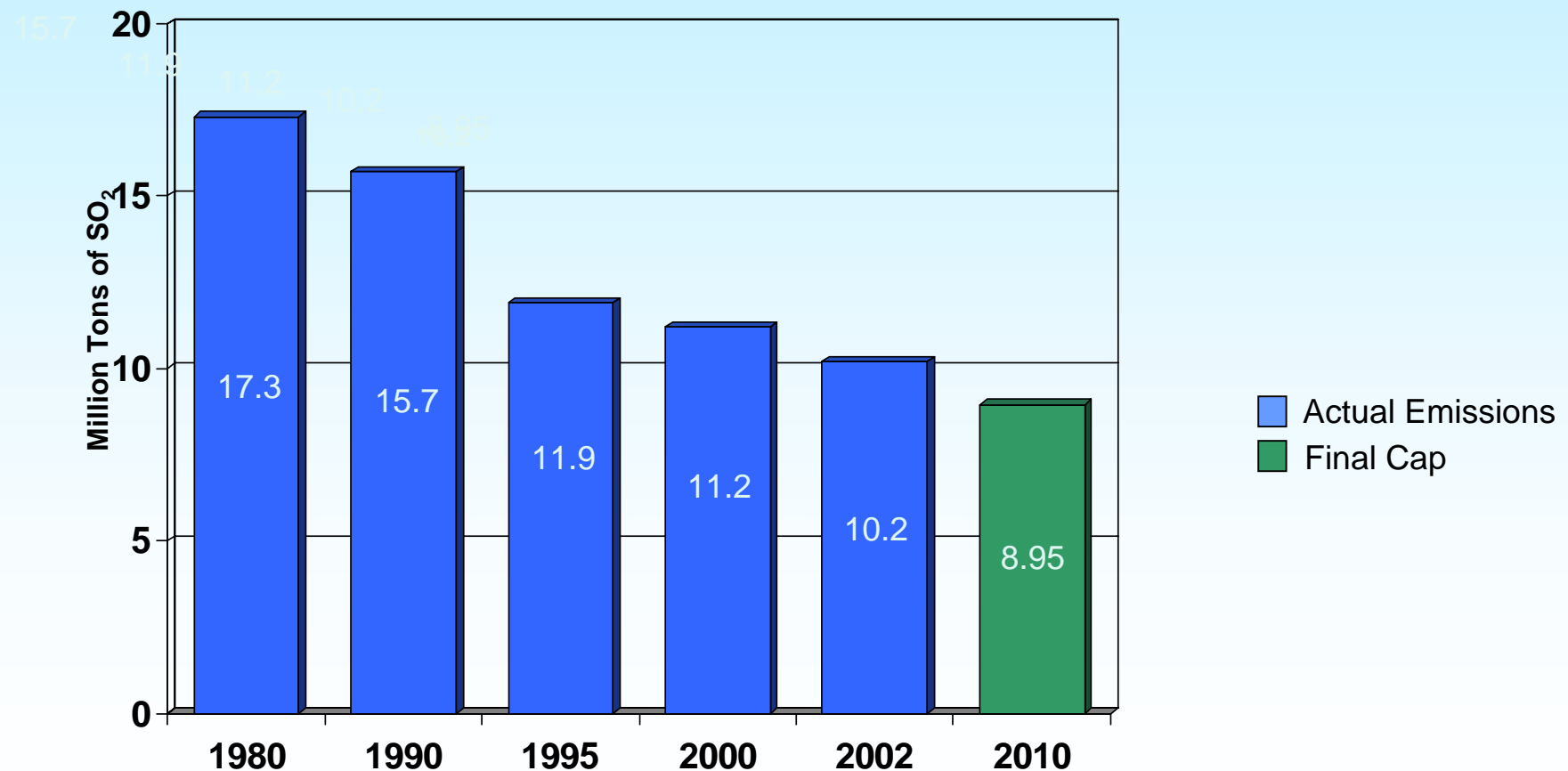
Goal of Title IV:

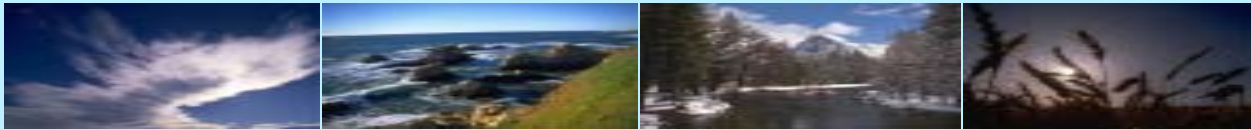
“reduce the adverse effects of acid deposition through reductions in annual emissions of sulfur dioxide of ten million tons from 1980 emission levels, and . . . of nitrogen oxides emissions of approximately two million tons from 1980 emission levels.”



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■ Major Reductions in SO₂ Emissions under the Acid Rain Program





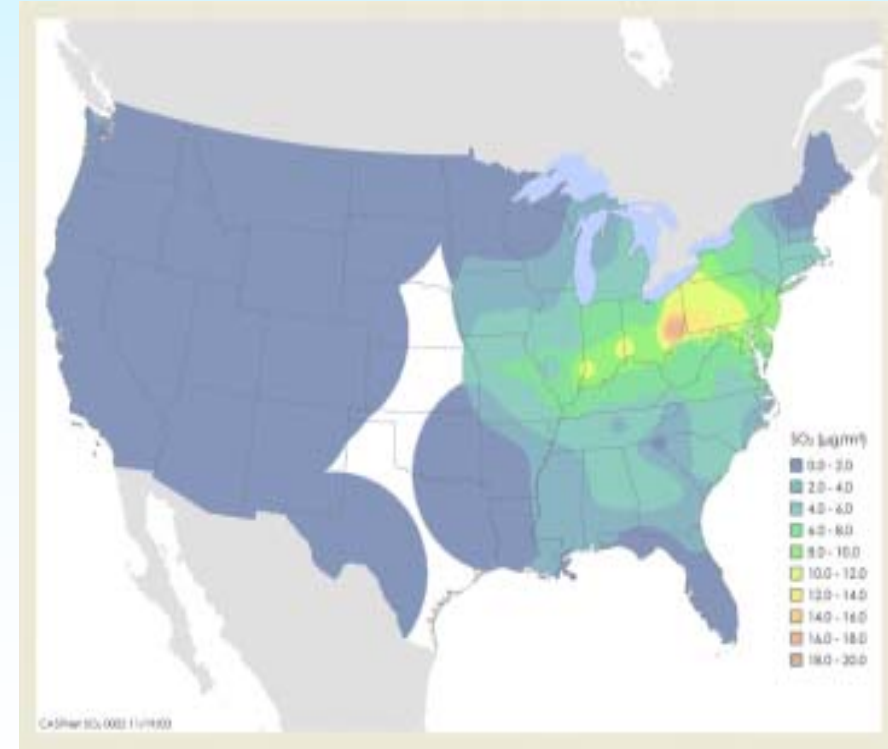
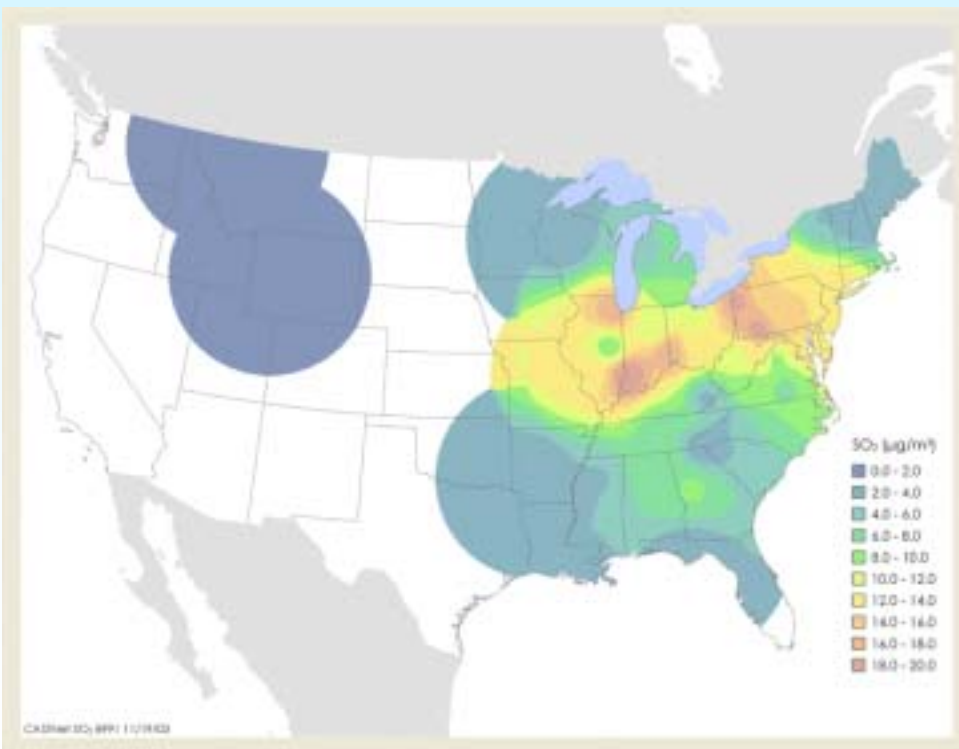
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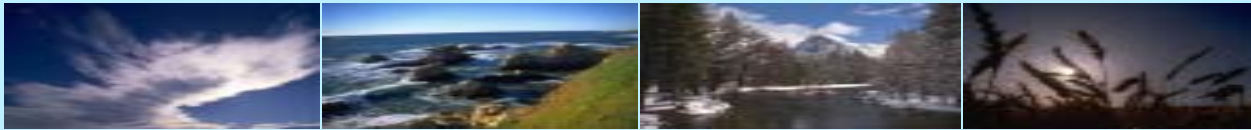
CASTNET Status and Trends in Rural Air Quality Concentrations

Gaseous Sulfur Dioxide (SO_2)

1989-1991

2000-2002

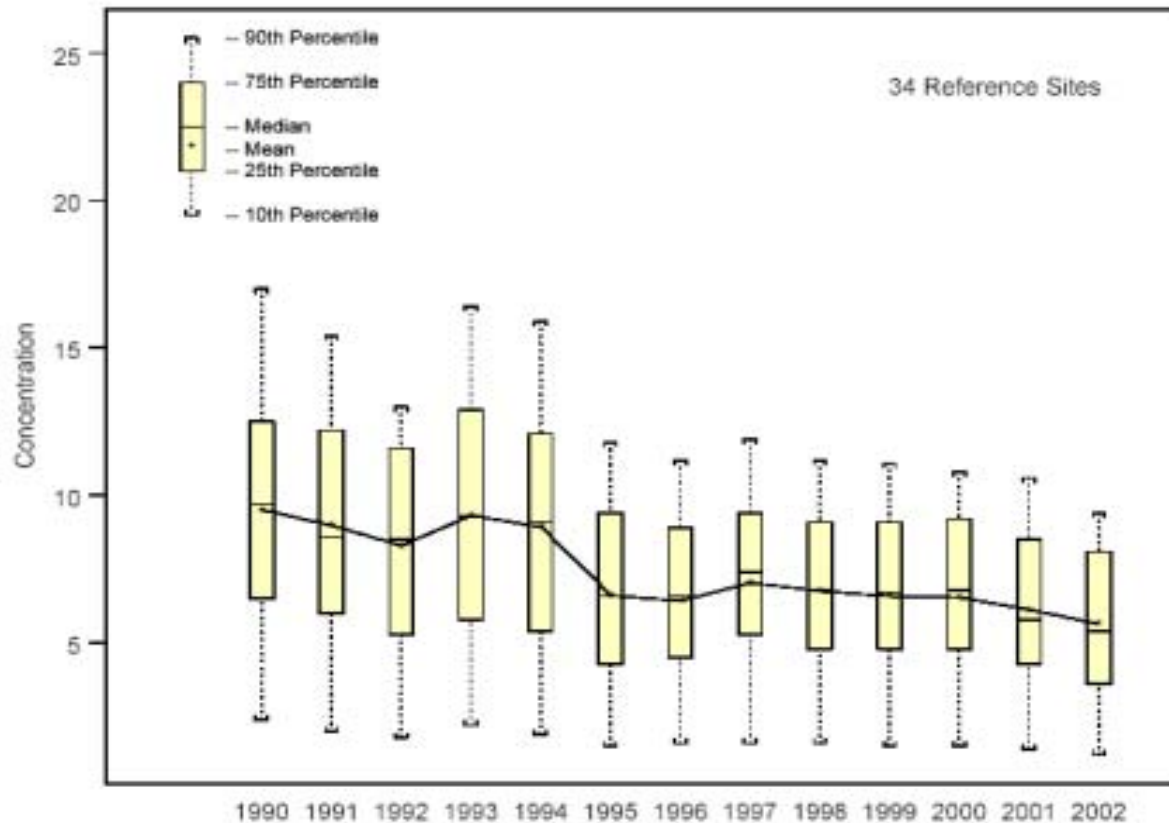


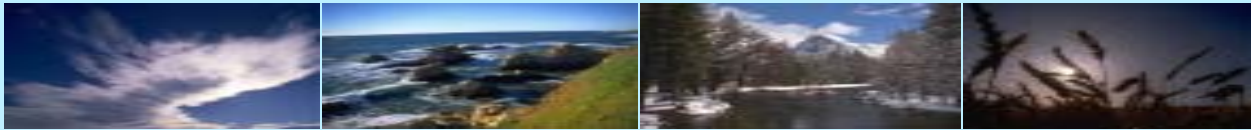


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Rural ambient concentrations of sulfur species track SO₂ emission reductions

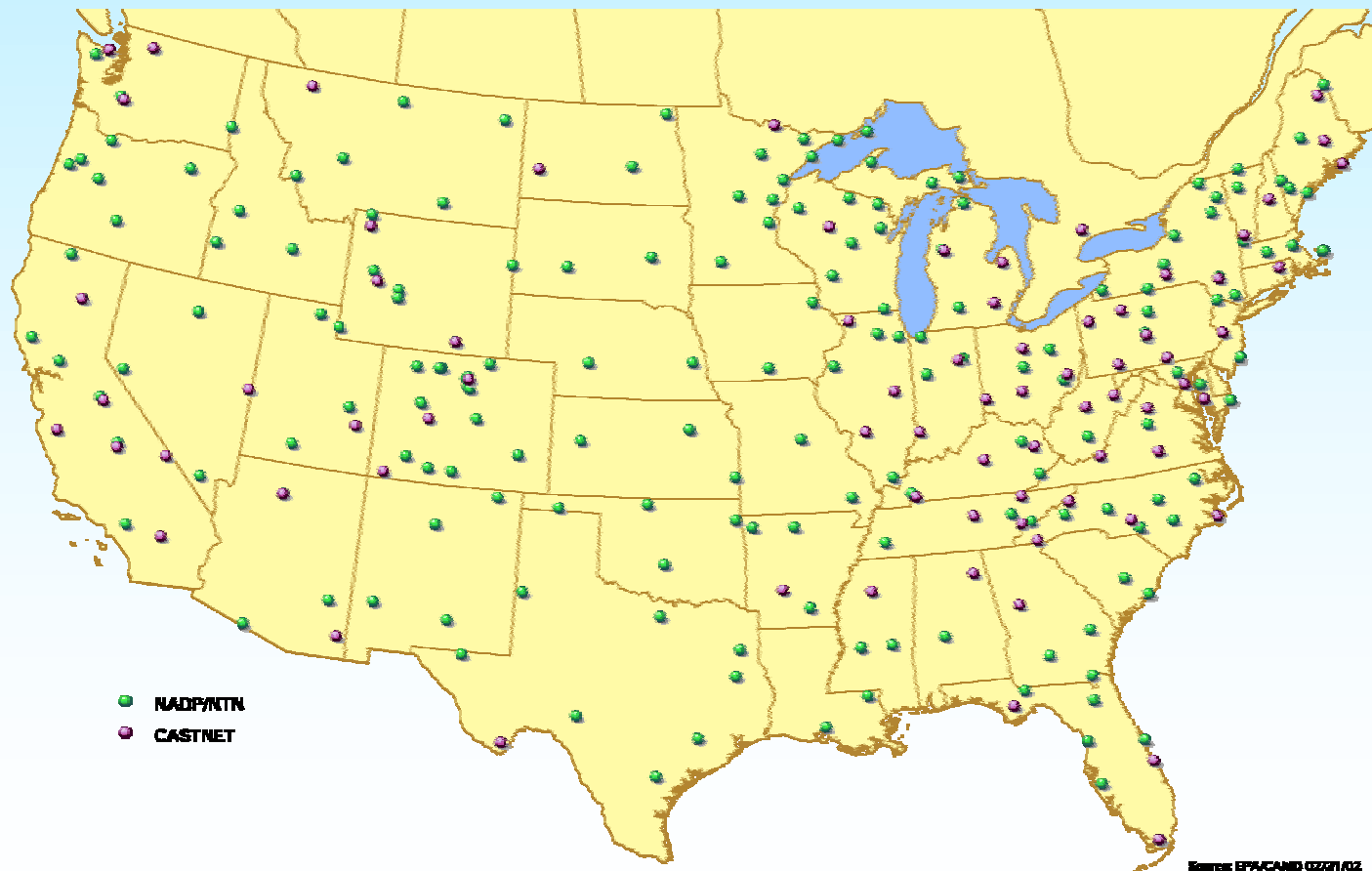
Trend in Annual SO₂ Concentrations (ug/m³) --- Eastern US

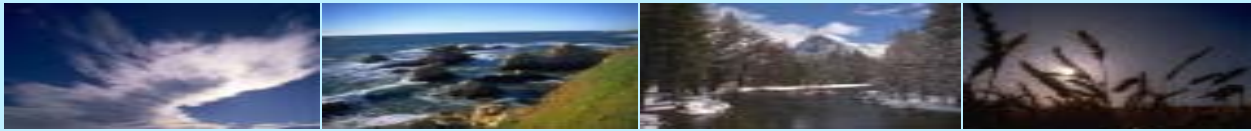




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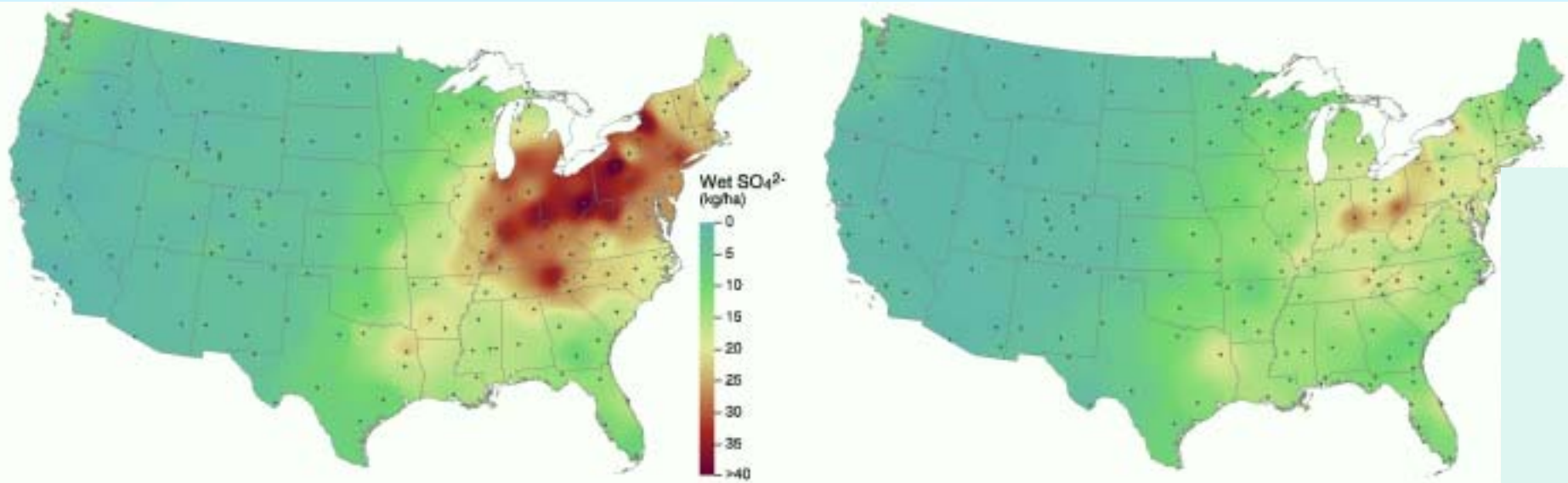
National Long-term Air Quality and Atmospheric Deposition Monitoring Networks





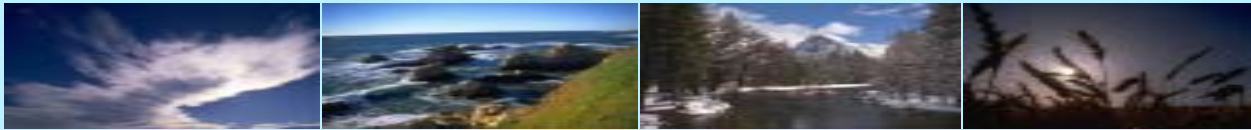
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■ Wet Sulfate Deposition 1989-1991 vs. 2000-2002



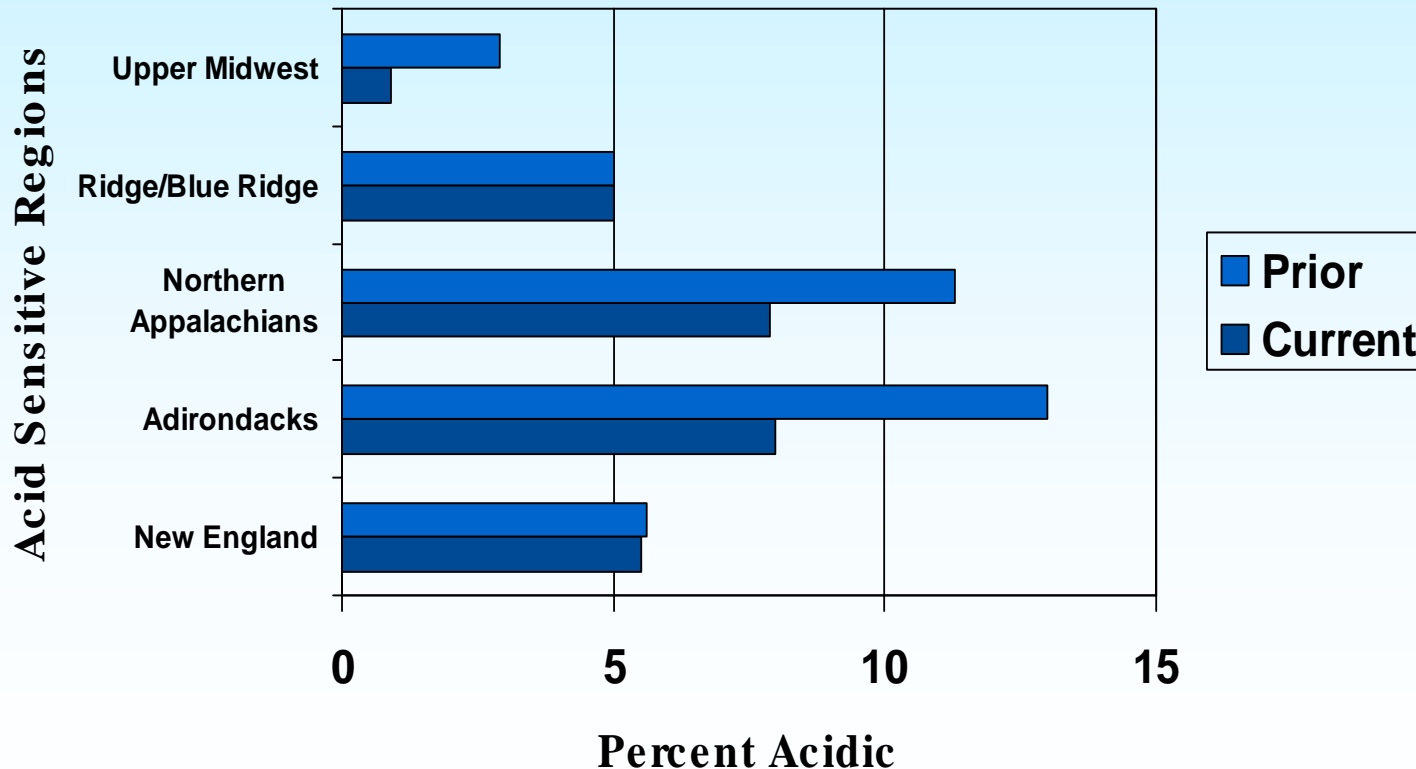
And the lakes?

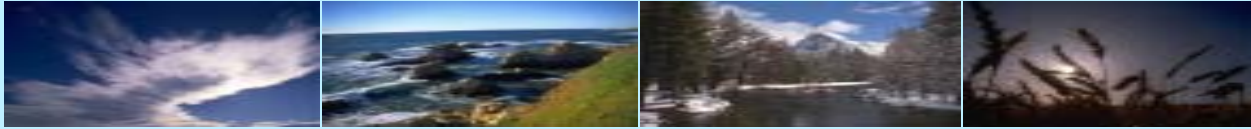




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Clean Air Act Amendments Survey Results

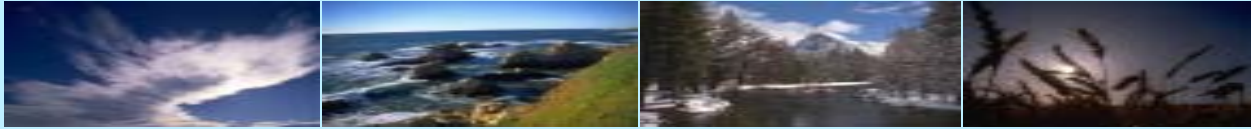




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■ Changes in Populations since CAAA

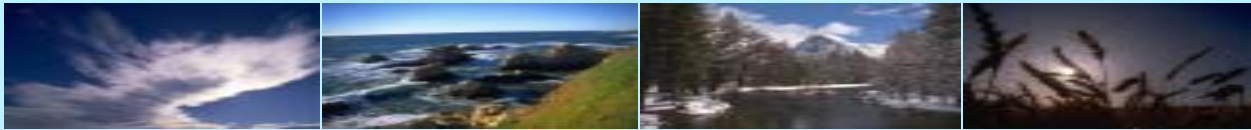
Region	Population Size	Number Acidic ¹	% Acidic ²	Time Period of Estimate	Current Rate of ANC change ³	Estimated Number Currently Acidic	Current % acidic	% Change in Number of Acidic Systems
New England	6,834 lakes	386 lakes	5.6%	1991-94	+0.3	374 lakes	5.5%	-2%
Adirondacks	1830 lakes	238 lakes	13.0%	1991-94	+0.8	149 lakes	8.1%	-38%
No. Appalachians	42,426 km	5,014 km	11.8%	1993-94	+1.0	3,393 km	7.9%	-32%
Ridge/Blue Ridge	32,687 km	1,634 km	5.0%	1987	-0.0	1,634 km	5.0%	0%
Upper Midwest	8,574 lakes	251 lakes	2.9%	1984	+1.0	80 lakes	0.9%	-68%



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■ Major Conclusions

- Large regional declines in surface water sulfate due to CAAA
- Regional “recovery” (increase in ANC) in two regions with largest proportions of acidic surface waters (Adirondacks, Appalachian Plateau)
- Ridge and Blue Ridge provinces continue to show lagged response – and no recovery
- Key uncertainties make prediction of future difficult – base cations, nitrate, organic acids

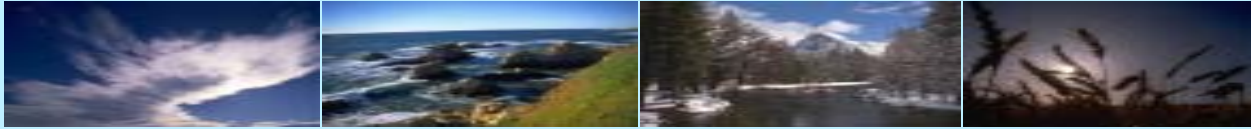


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1. Recovery in Adirondacks and Appalachian Plateau may be partially attributed to **nitrate** declines:

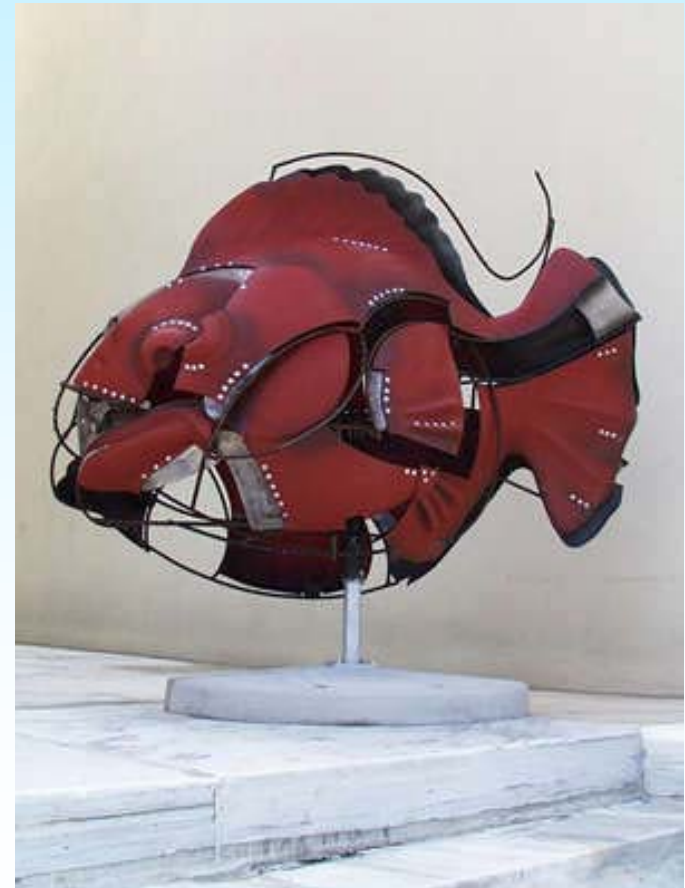
Region	Reported ANC increase	Estimated ANC increase if NO ₃ unchanged	Estimated ANC increase if NO ₃ increased
Adirondacks	+1.0 µeq/L/yr	+0.9 µeq/L/yr	+0.7 µeq/L/yr
Appalachian Plateau	+1.9 µeq/L/yr	+1.2 µeq/L/yr	+0.5 µeq/L/yr

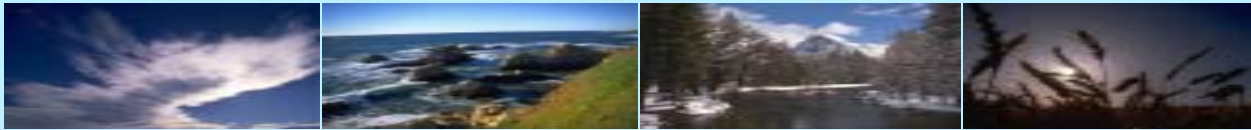
2. Lack of recovery in New England (and individual sites in other regions) due to unexplained large declines in **base cations**
3. Not known how much “replacement” of mineral acids (SO₄, NO₃) with **organic acids** will occur



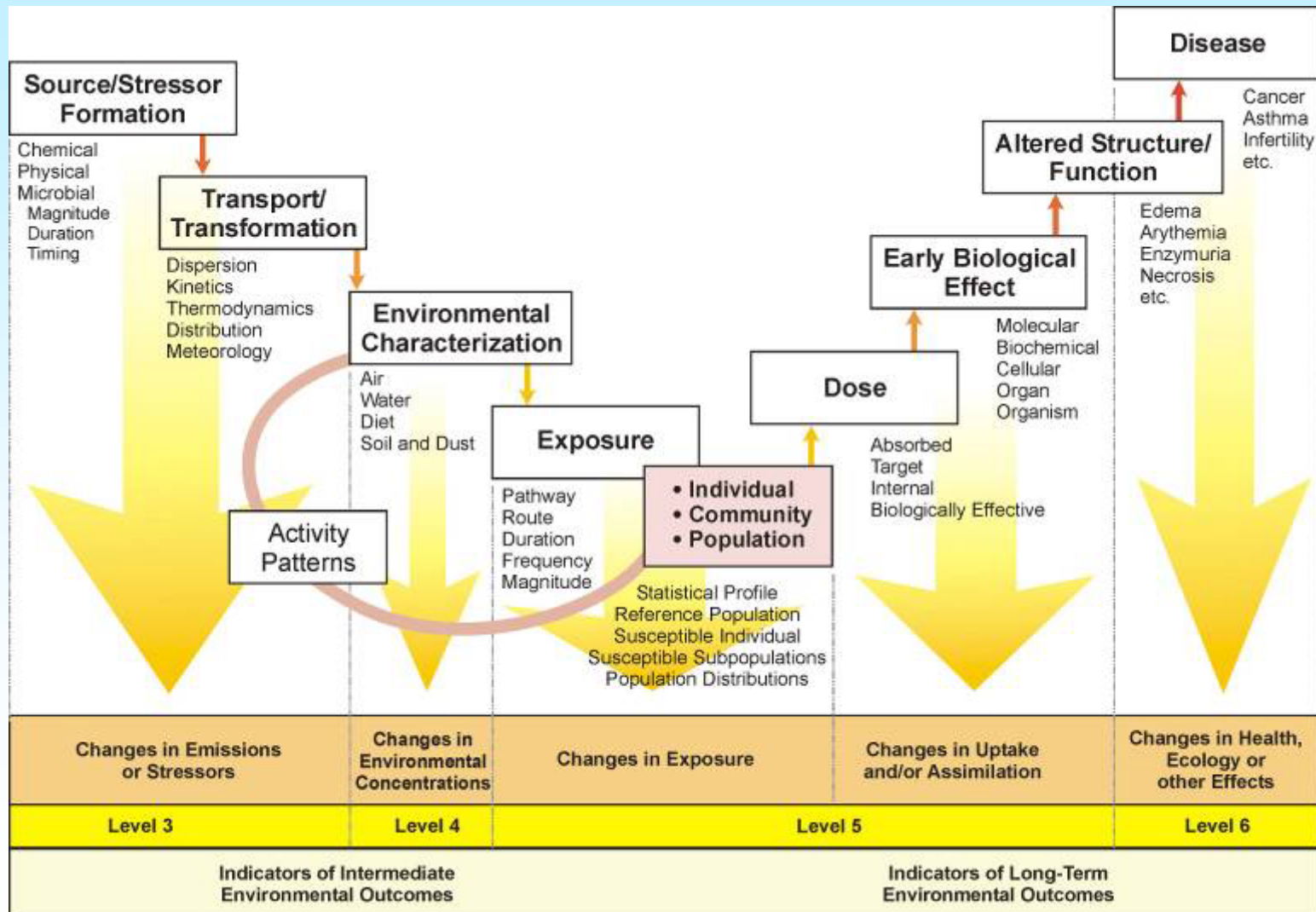
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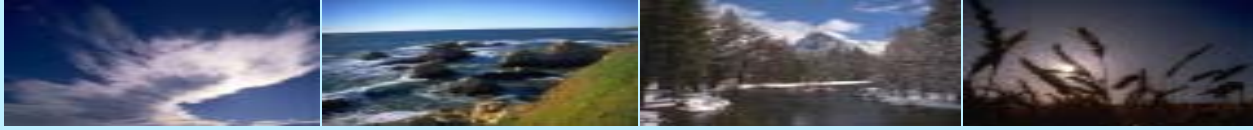
■ And the Fish????





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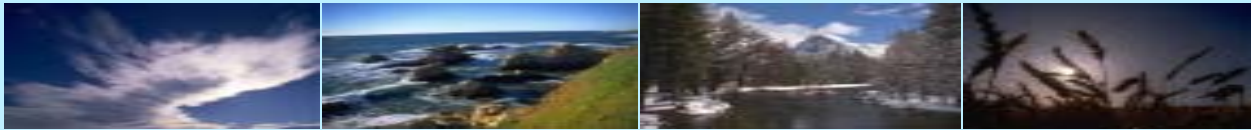




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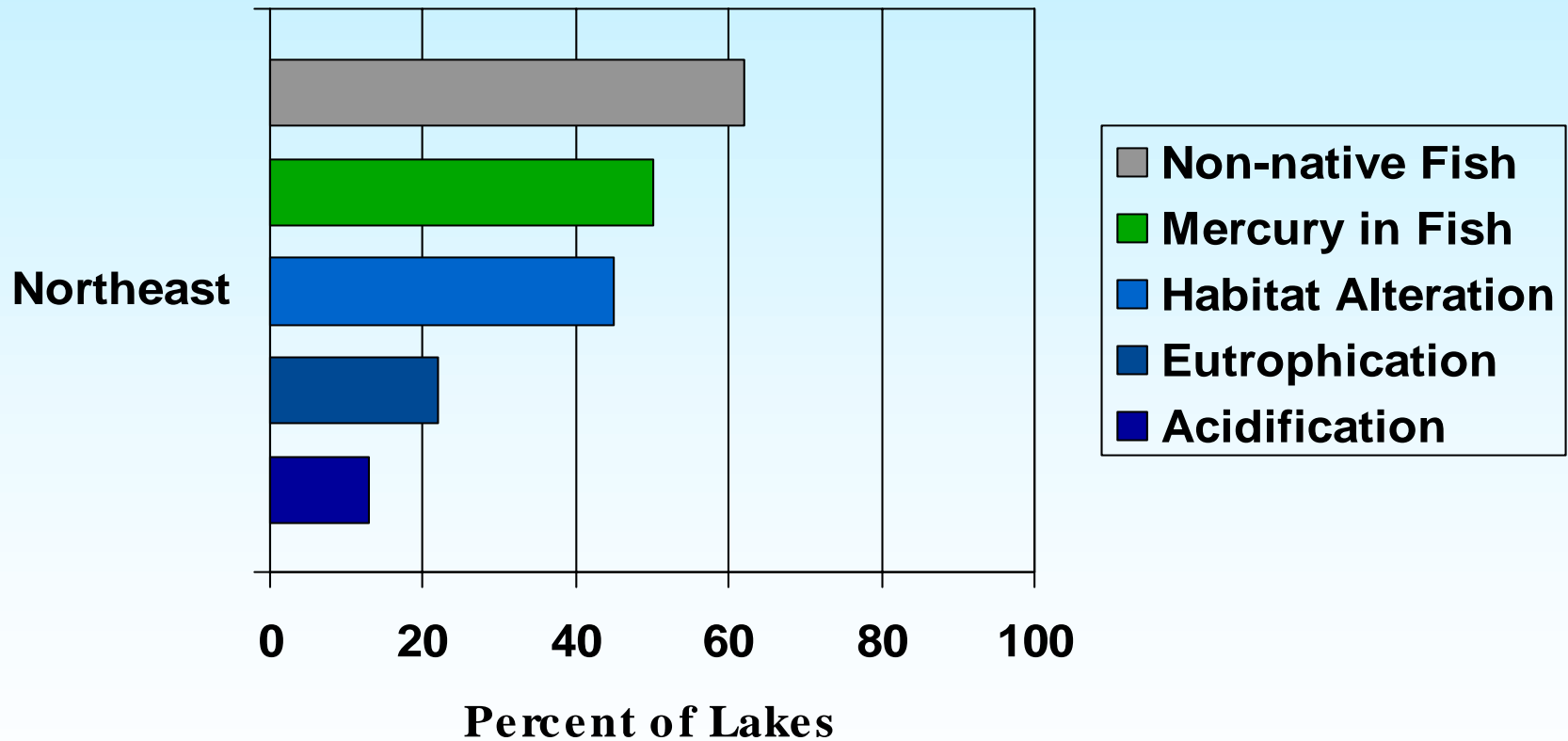
■ Next Level of Question

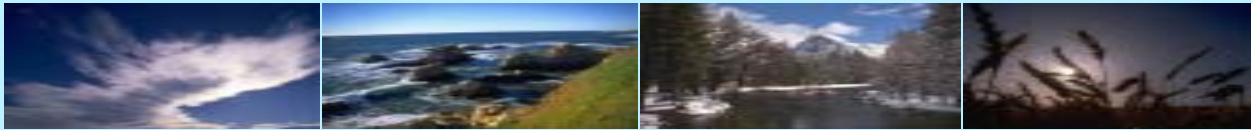
Now that we know how big the problem is, how large is that compared to other stressors on lakes or streams in that region?



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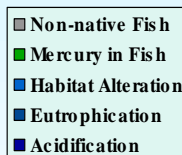
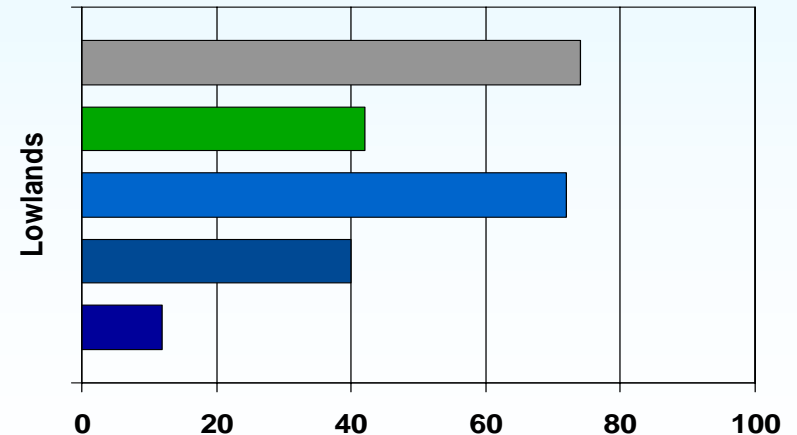
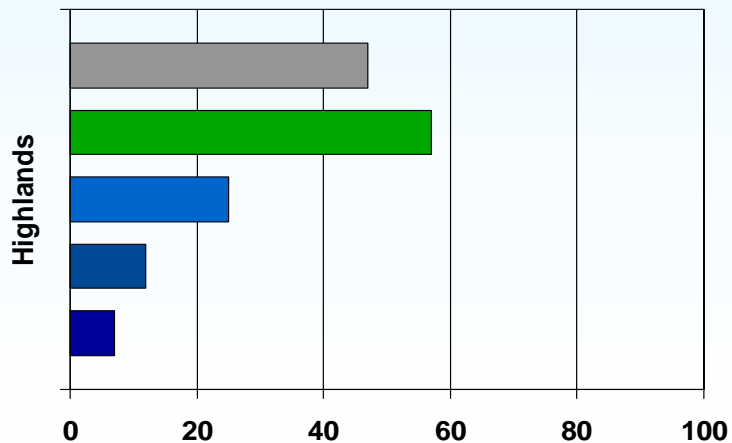
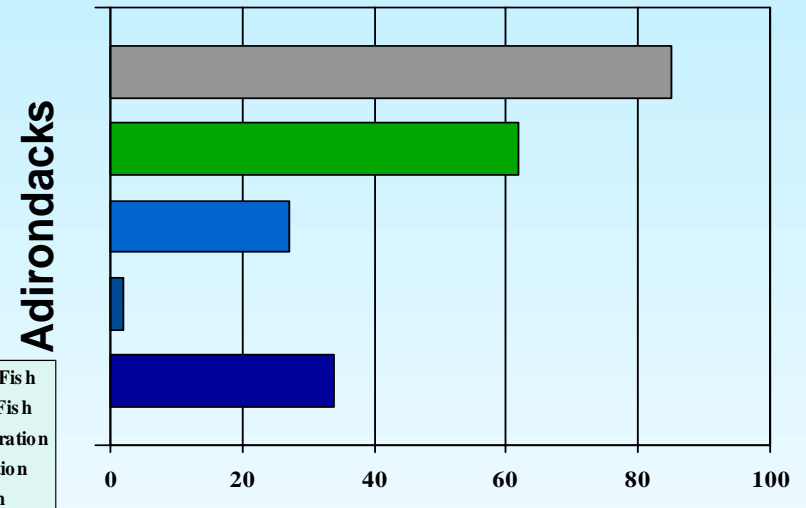
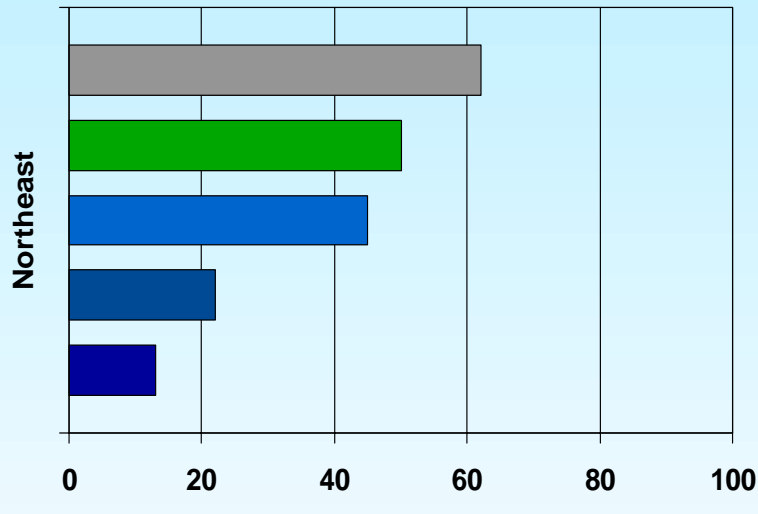
■ Stresses to Northeast Lakes

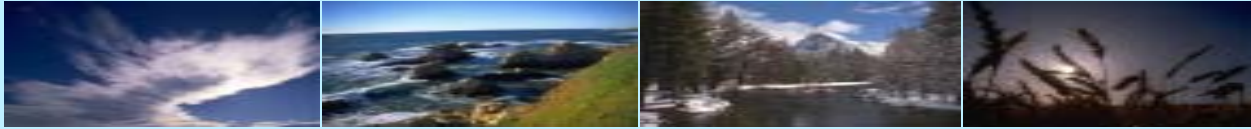




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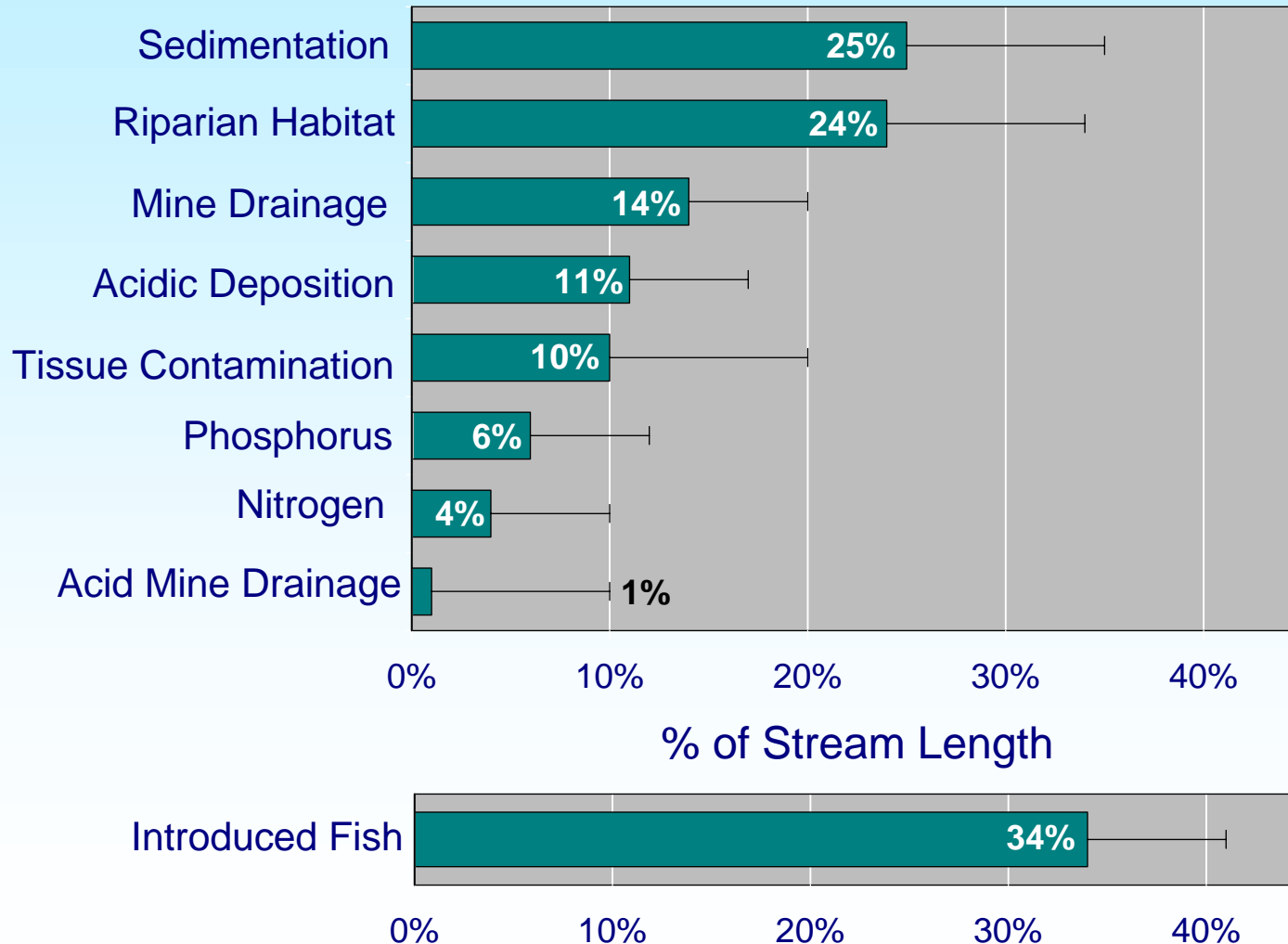
■ Northeast Lakes

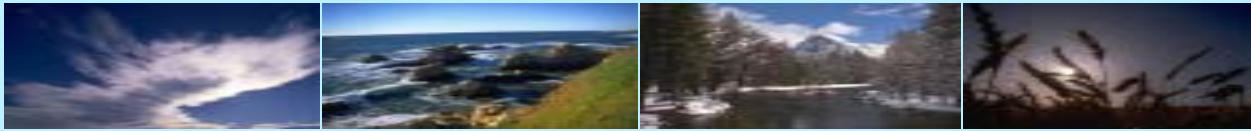




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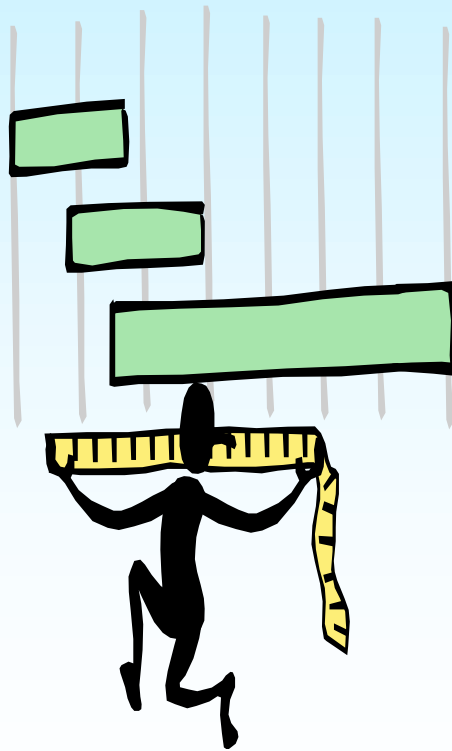
Stresses in mid-Atlantic Streams



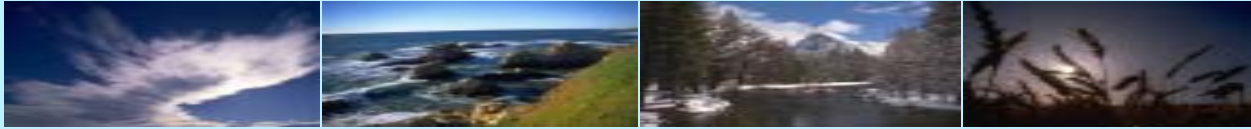


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■ Looking Ahead to Now

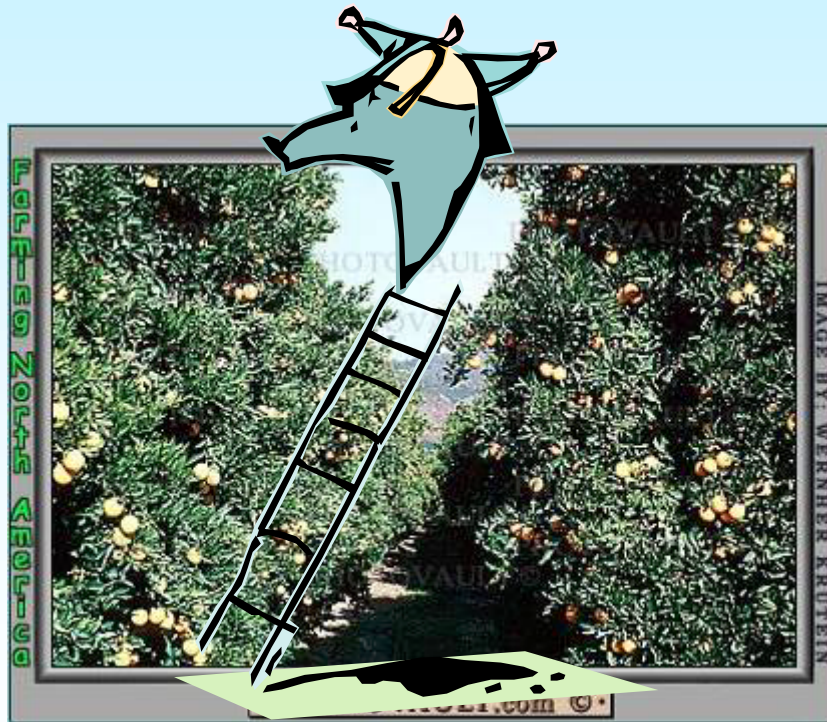


- There are many indicators, measures, indices....ready today!
- So, where is the data?
- In the simplest form...we
 - Lack the leadership
 - Lack the cooperation, coordination, compromise, consistency and commitment
 - Lack sound designs

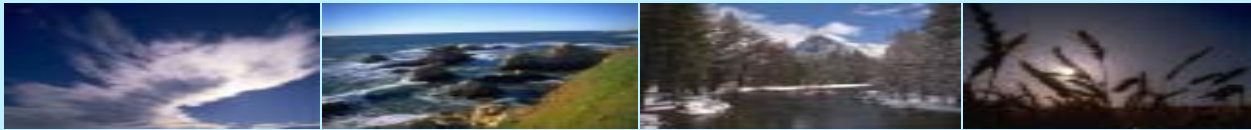


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■ Where do we spend our effort

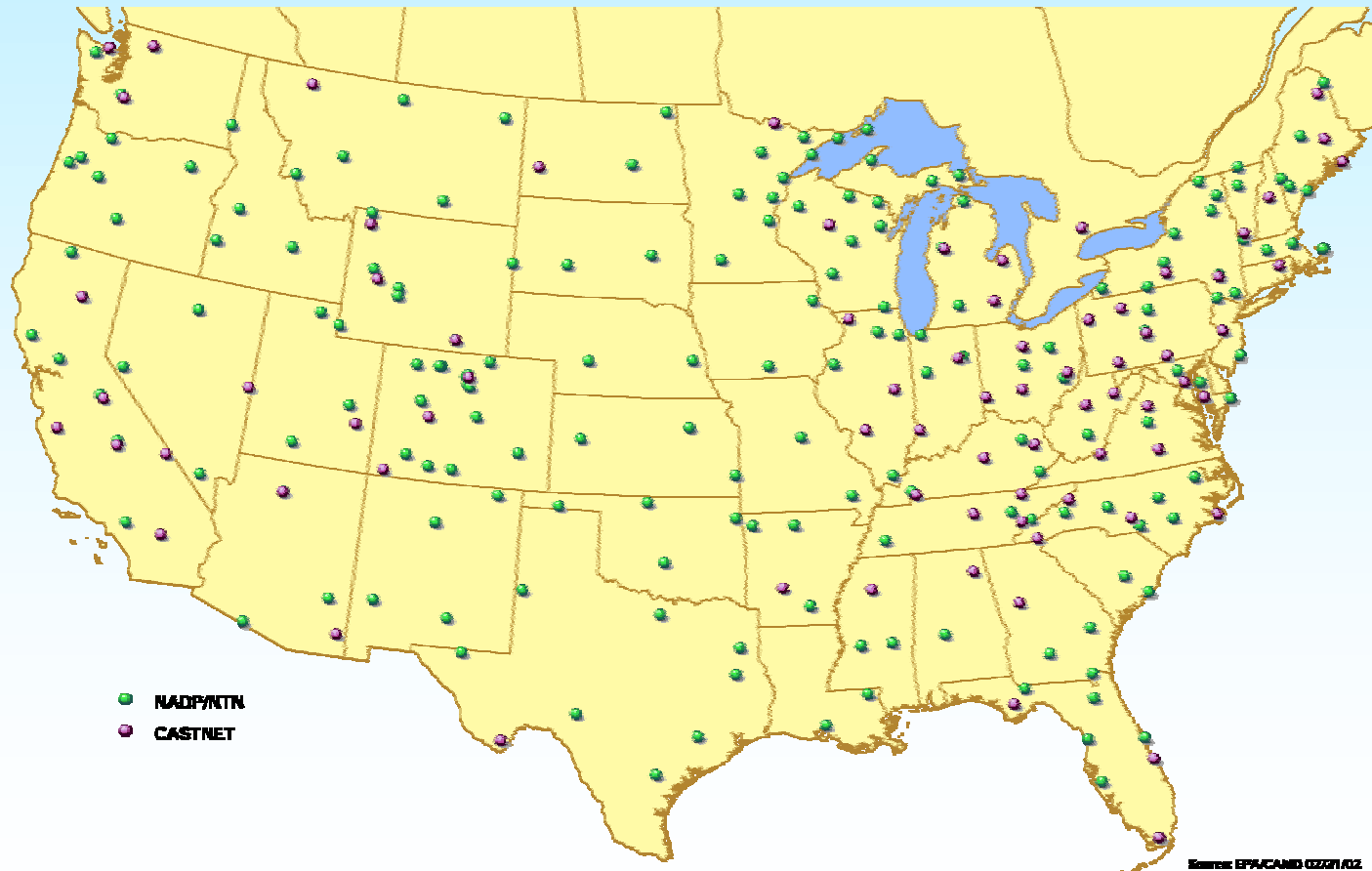


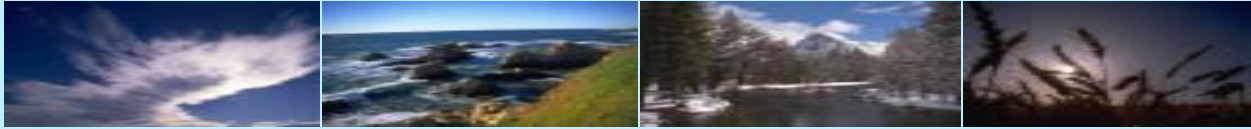
- What about the fruit in front of us?
 - Common indicators
 - Common methods



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National Long-term Air Quality and Atmospheric Deposition Monitoring Networks

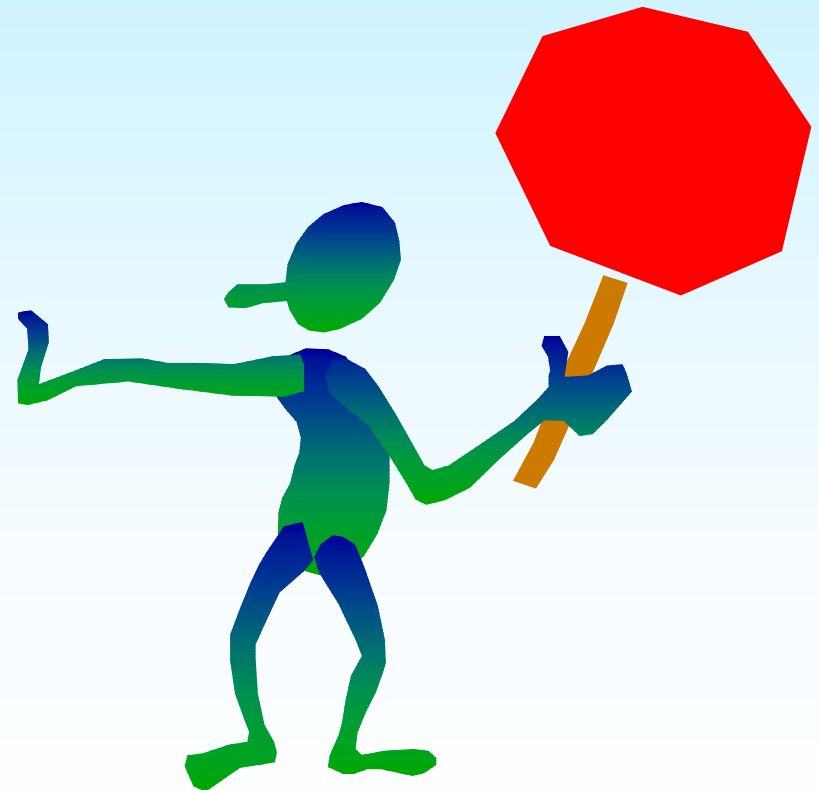


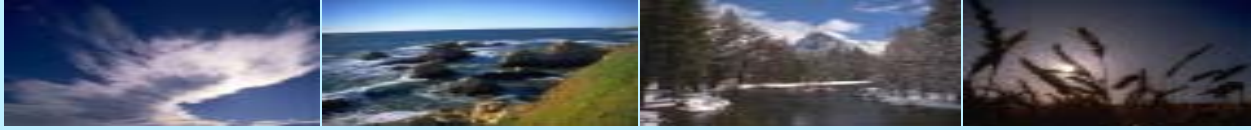


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■ And remember.....

- The right indicator does not automatically get you the right answer!





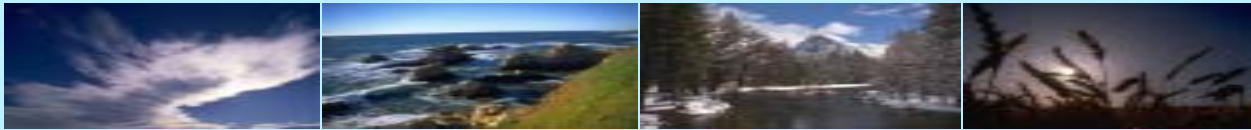
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■ Designs

Evolution



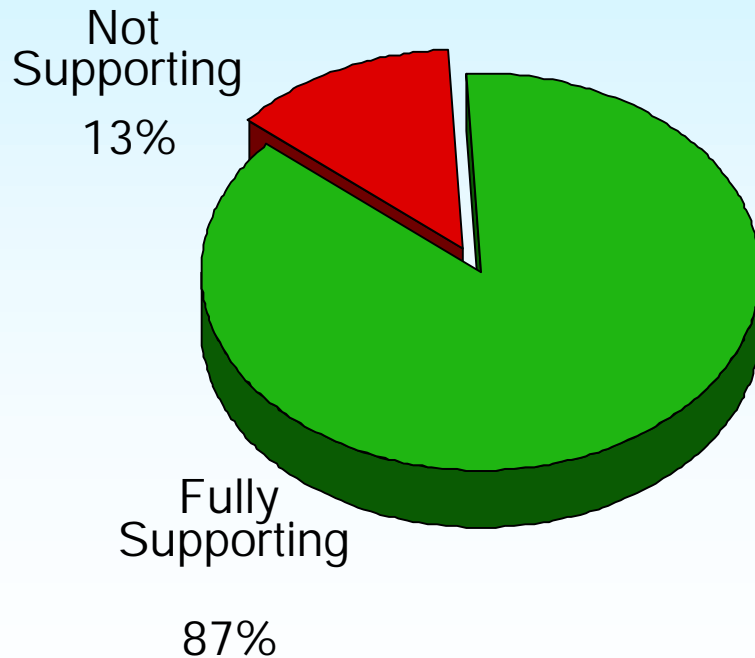
- Casual/Convenient/Intuitive
- Enumeration
- Case Study
- Representative or Typical
- Quota
- Systematic
- Partial Probability
- Probability



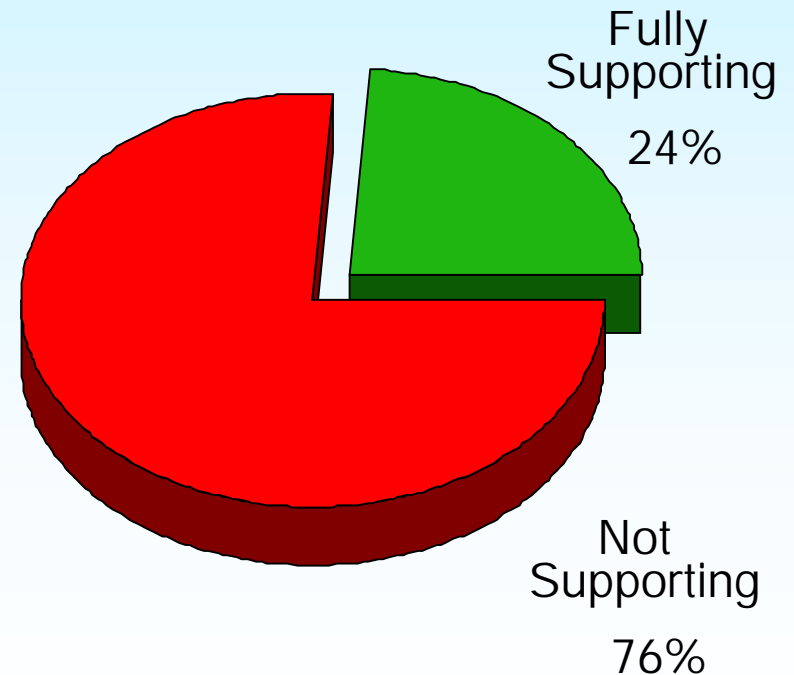
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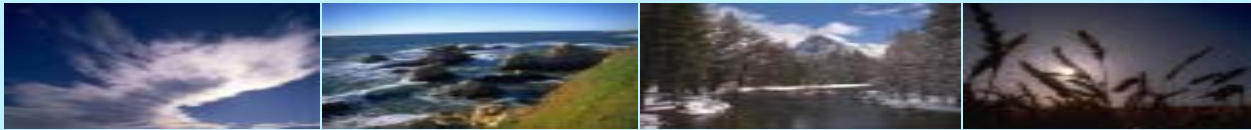
■ Importance of Indicators & Survey Design Delaware Stream Reporting (Courtesy of EMAP)

Traditional 305(b) Report



Probability Survey

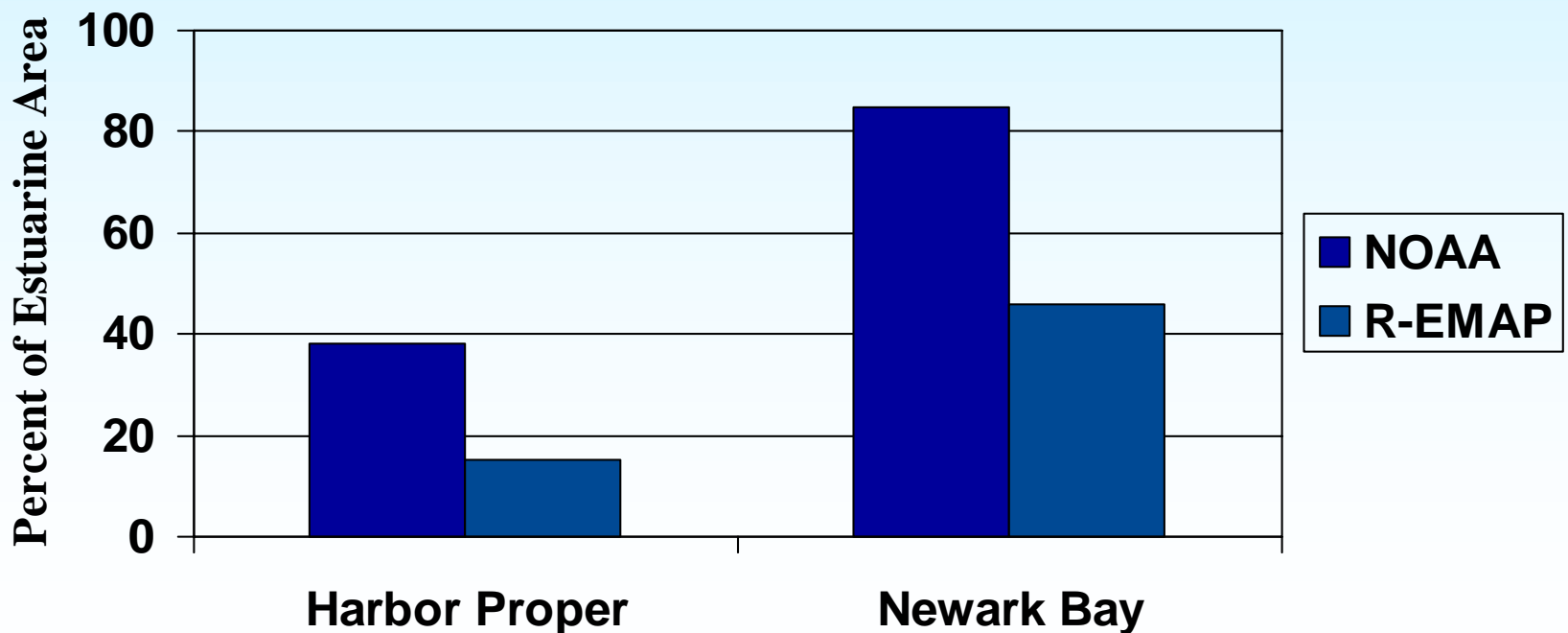


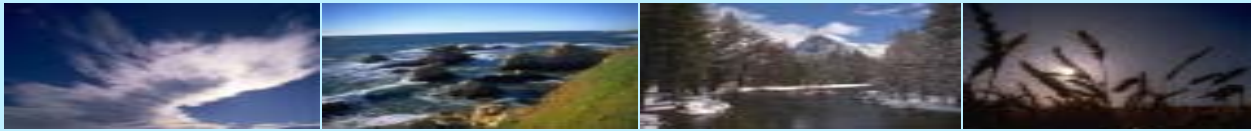


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■ **State of Information**
Monitoring Survey Design (Courtesy of EMAP)

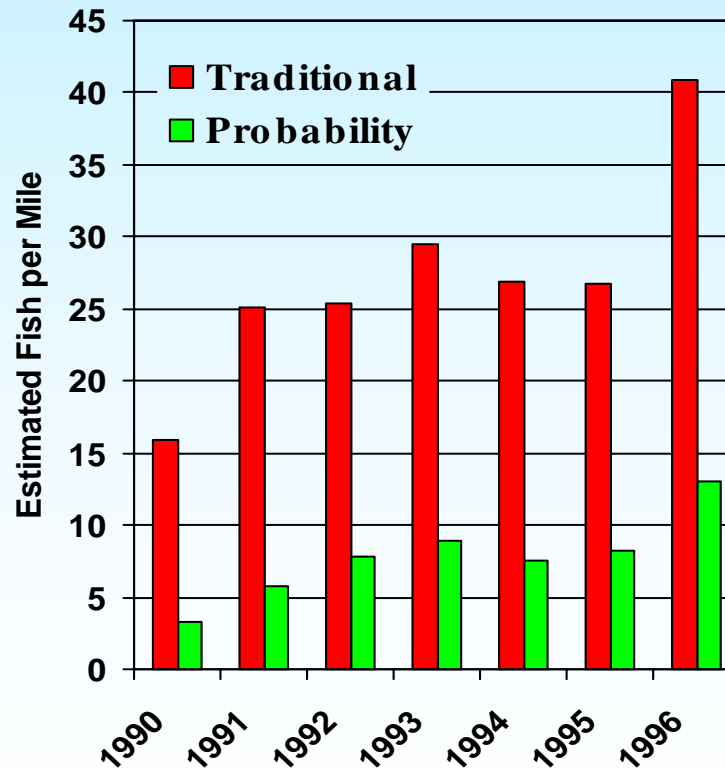
New York/New Jersey Harbor
Sediment Toxicity





A catalyst for environmental improvement

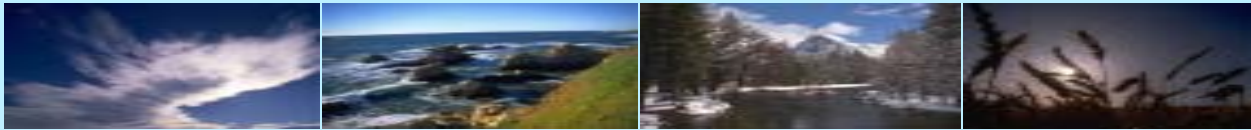
■ Importance of Monitoring Survey Design Oregon Coastal Coho Salmon (Courtesy of EMAP)



Side of the 1980s --- Truth Today?

LIMITATIONS OF AVAILABLE DATA

- * Differences in methodology
- * Biased selection of sampling sites
- * Chemically incomplete
- * Poor or unknown quality
- * Little data available



A catalyst for environmental improvement

■ Questions for the collective coalition

- What progress has been made since the first SoER?
- How different can the report of 20XY be?
- What will it take to make some obvious changes that are needed?
 - Leadership from the Administrator?
 - Commitment by us demonstrating the will of the Agency?
 - Resources and/or new laws from Congress?

